Status of Efforts to Reduce In-Use NOx Emissions from On-Road Heavy-Duty Diesel Vehicles (Element M17 of the California SIP)

Board Update

California Environmental Protection Agency

Air Resources Board

Outline

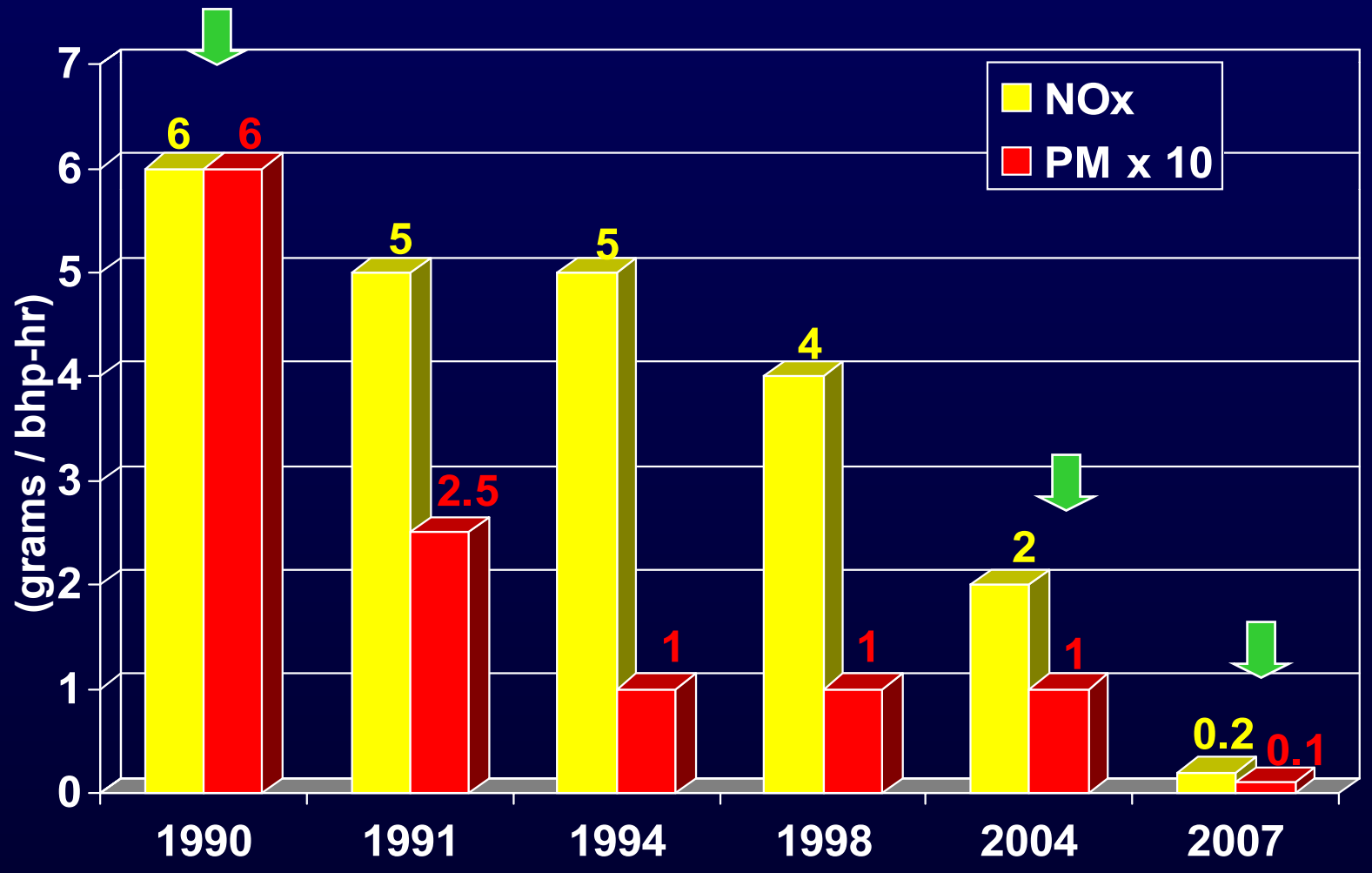
- Heavy-duty diesel engine (HDDE) background
- SIP Measure M17, reduce in-use emissions from on-road HDD vehicles
  - HDDE NOx field screening program
  - HDDE in-use compliance program
  - Heavy-duty on-board diagnostic program
  - NOx reduction incentive programs

HDDE Background

- Importance of on-road HDDE
  - Superior fuel efficiency and durability
  - Vital to the transport of goods and material

- Drawbacks of diesel engines
  - NOx-precursor to ozone and secondary PM
  - PM-toxic air contaminant

HDDE Emission Standards
New On-Road Engines



Emission Regulations: Cars vs. Trucks

- Stringent LEV standards
- Effective in-use compliance program
- Effective Smog Check
- OBD II since 1996

- Stringent Standards
- No in-use Compliance testing
- Smoke inspection only
- No OBD

Elements of SIP Measure M17

- Emission reductions from in-use HDDEs
- 10 TPD NOx, 1 TPD ROG in SCAB 2010
- Strategies to be considered
  - HDDE NOx field screening program
  - HDDE in-use compliance test program
  - Heavy-duty on-board diagnostic program
  - Pursue incentives

Development of Heavy-Duty Diesel Engine Field NOx Screening Program

Development of a Field NOx Screening Test

- How Would the Program Work?
- Portable dynamometers set up at roadside locations
- Enroute heavy-duty trucks would be detached from trailers
- Emissions testing for excess NOx conducted
- Repairs required for failing trucks

Critical Questions to Determine Value of Program

1. Are there excess NOx emissions in the vehicle population that are caused by tampering & malmaintenance?
2. Is there a practical field test that can identify those vehicles with high NOx emissions?
3. Can these excess NOx emissions be reduced through repairs and maintenance?
4. Can the reduction be made cost-effectively?

Stockton Laboratory

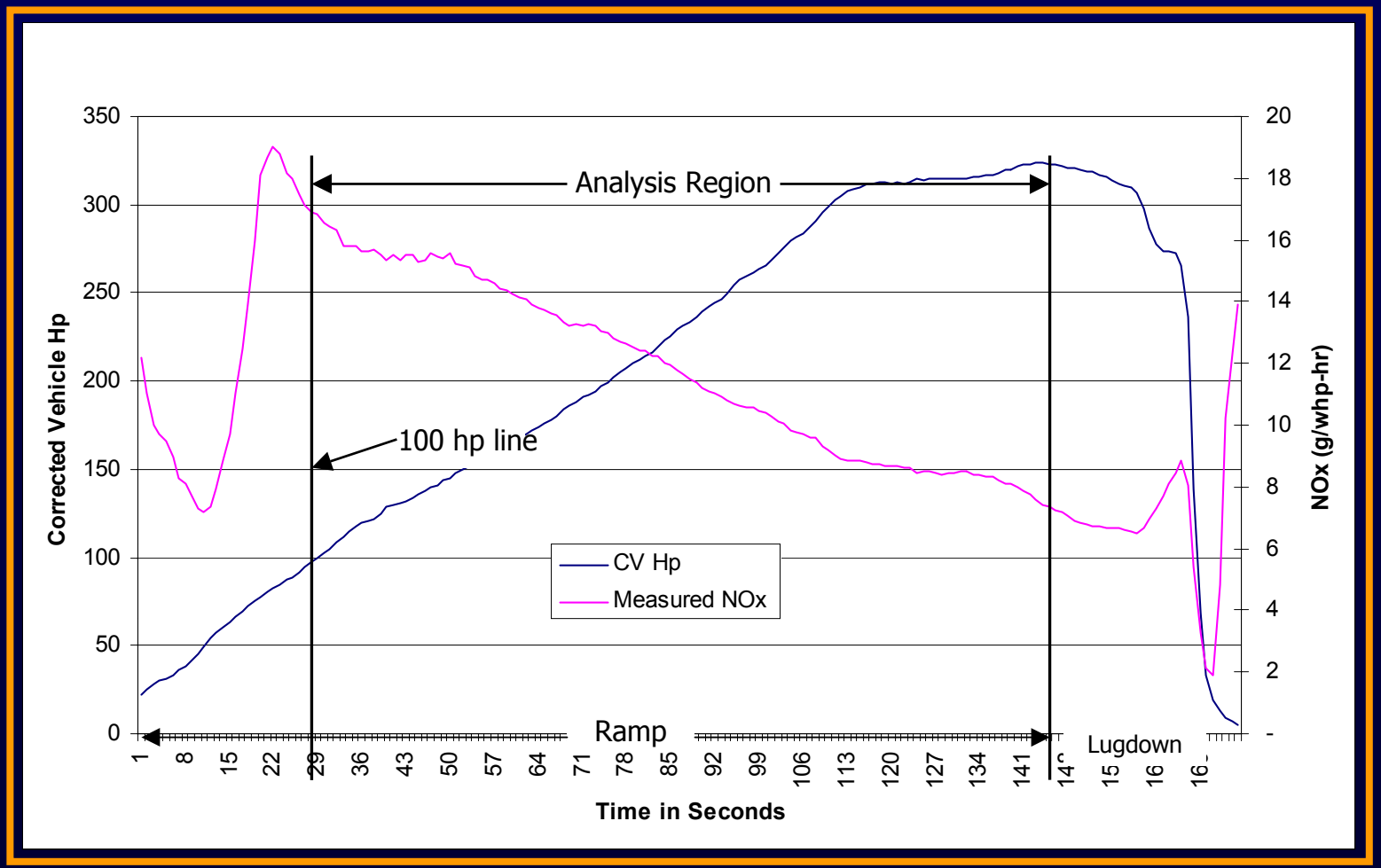
Truck ready for testing.

ARB staff performing power curve test.

Laboratory grade emissions analyzers.

Clean lab ready for next truck.

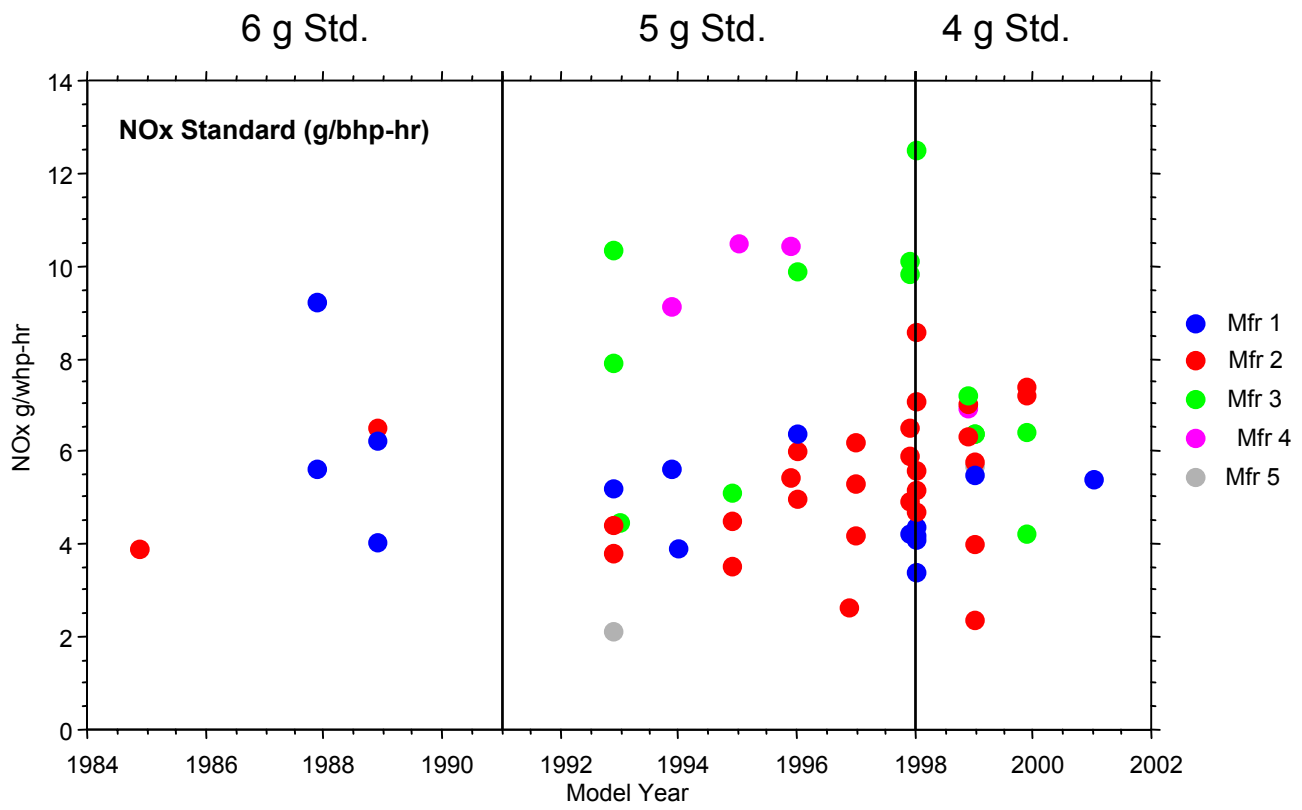
Powercurve Test Cycle



Vehicles Testing Summary

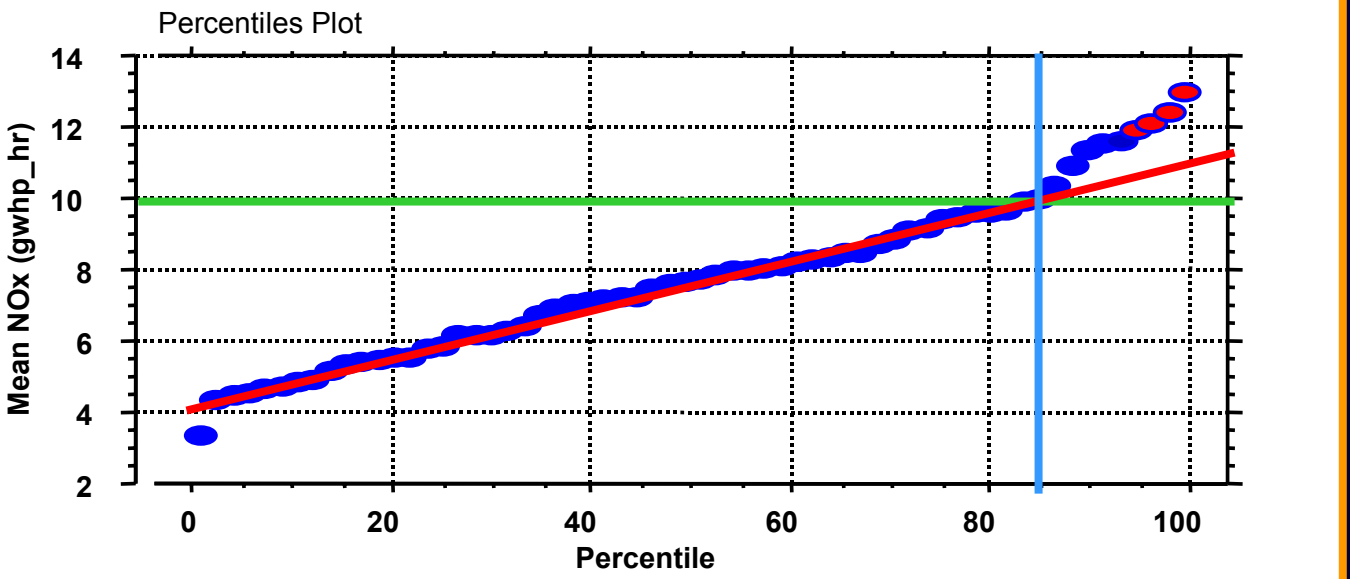
- 67 vehicles tested
- Selection designed to characterize HDD Vehicle Fleet
- 1291 total tests conducted
- 21 vehicles sent for repair

Baseline NOx Test Results by Model Year

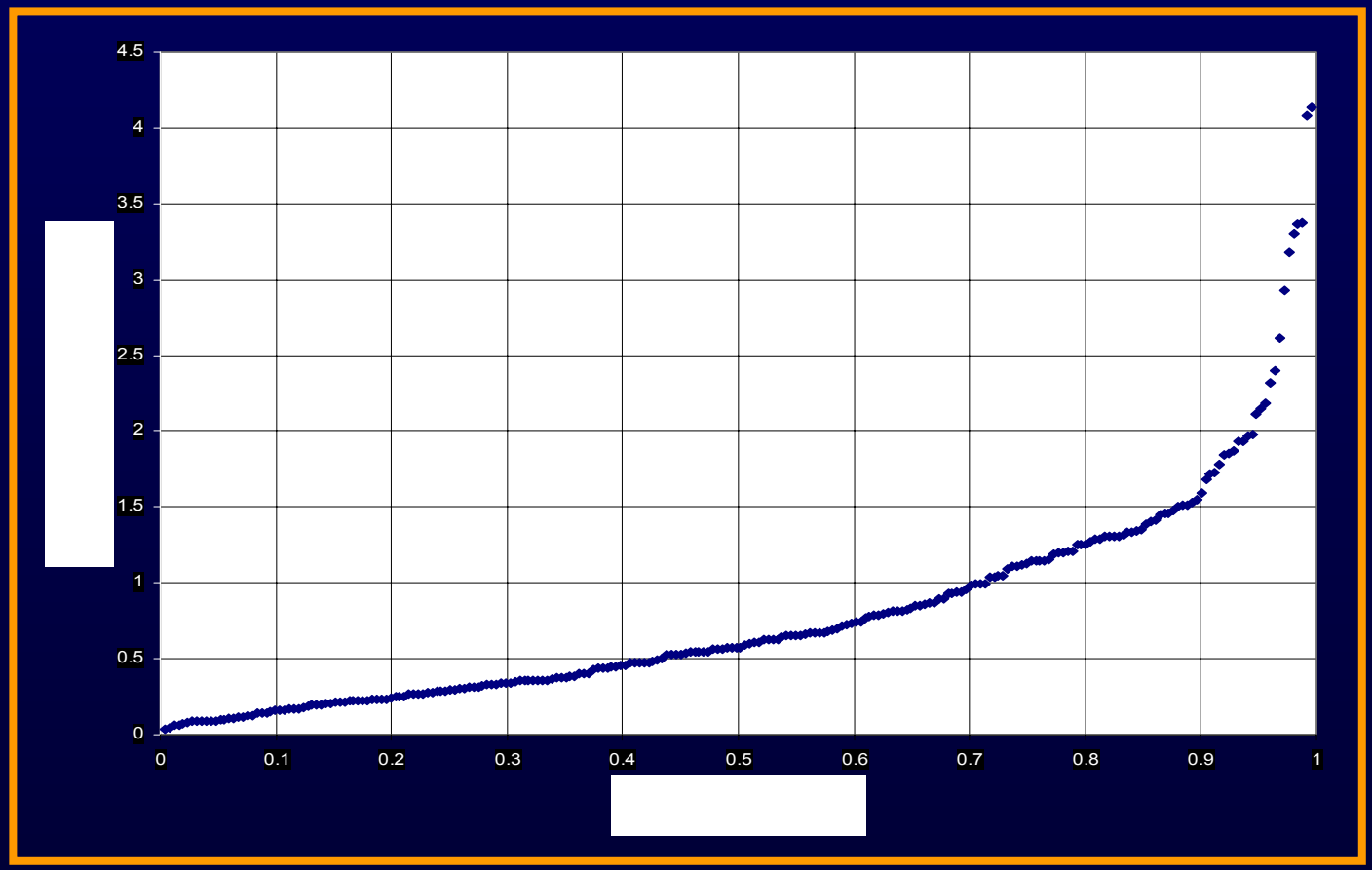


What Percentage of HDD Population can be Characterized as High NOx Emitters?

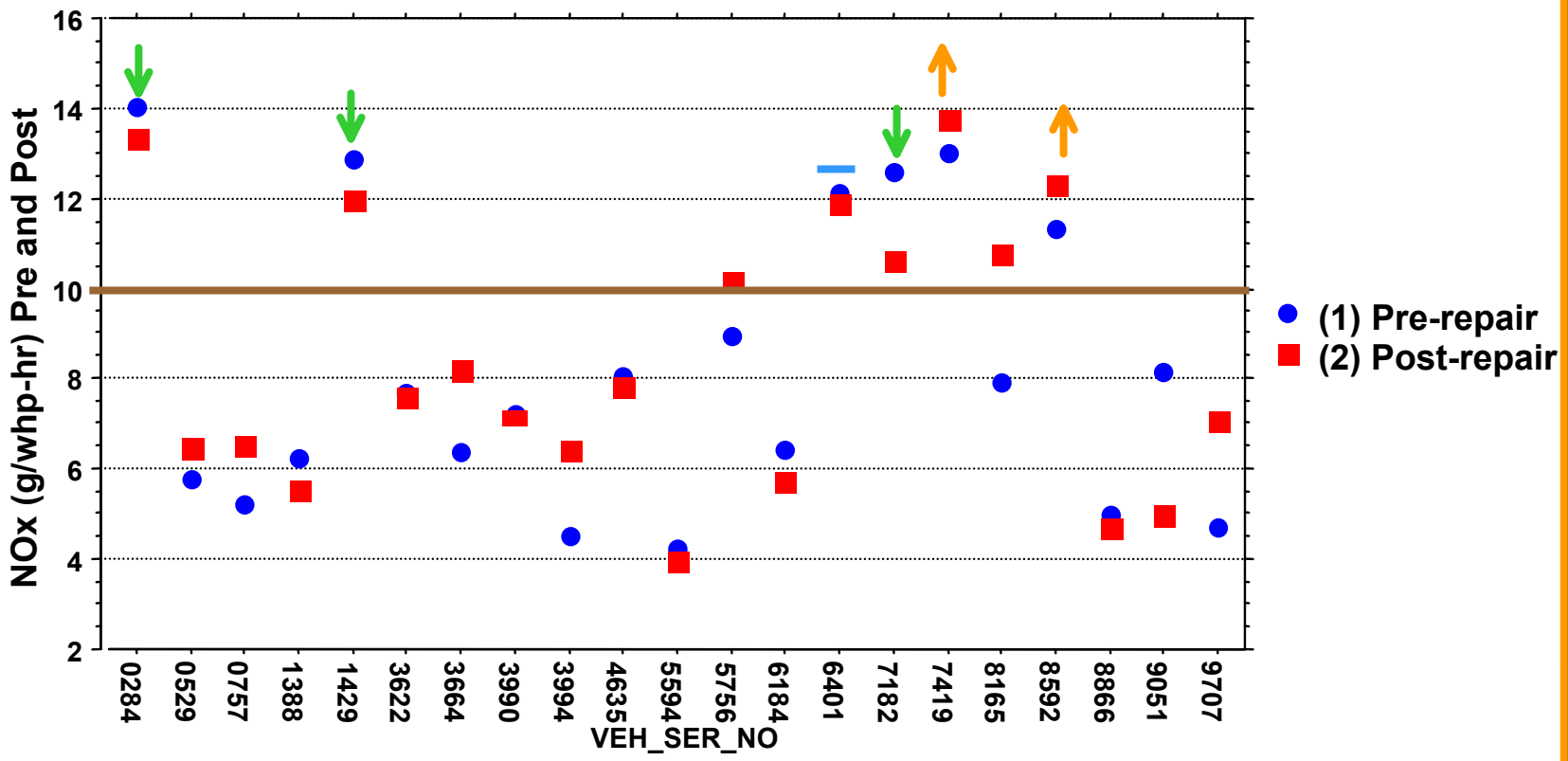
- 15 percent may have excess NOx
- Highest emitter group constitutes 5% of the population, >12 g/whp-hr.
- No clear line between high and normal emitters



Surveillance 15: LDT/MDV



Effect of Repairs on NOx Emissions (g/whp-hr)



Mechanical Repairs Only N = 21

Reflashes not included

Effects of Repairs (10g/whp-hr cutpoint)

- 3 trucks showed emissions decrease
- 2 trucks showed emissions increase
- 1 truck unchanged

- Average reduction / per truck repaired:
  - 2.1%
  - Approx. 3TPD reduction in South Coast
- Average Repair cost: $1018

NOx Screening Program Status

- Current data indicates difficulty in developing a NOx screening test
  - Per vehicle emission reductions from repair are minimal
  - No clear cut point to screen out high emitters
- ARB will continue to investigate magnitude and causes of high NOx emissions from HDD vehicles

Heavy-Duty Diesel In-Use Compliance Program

Compliance Testing

- Objective: Identify designs that fail to control emissions; correct with recall
- Current Obstacles
  - Need to test engine as it was certified
  - Time consuming: requires removal of engine
  - Expensive: approximately $300K-$700K
  - Impact on vehicle owner/operator: require truck for lengthy period; difficult to provide loaner truck

→Obstacles can be overcome based on the "Not-to-Exceed" (NTE) concept.

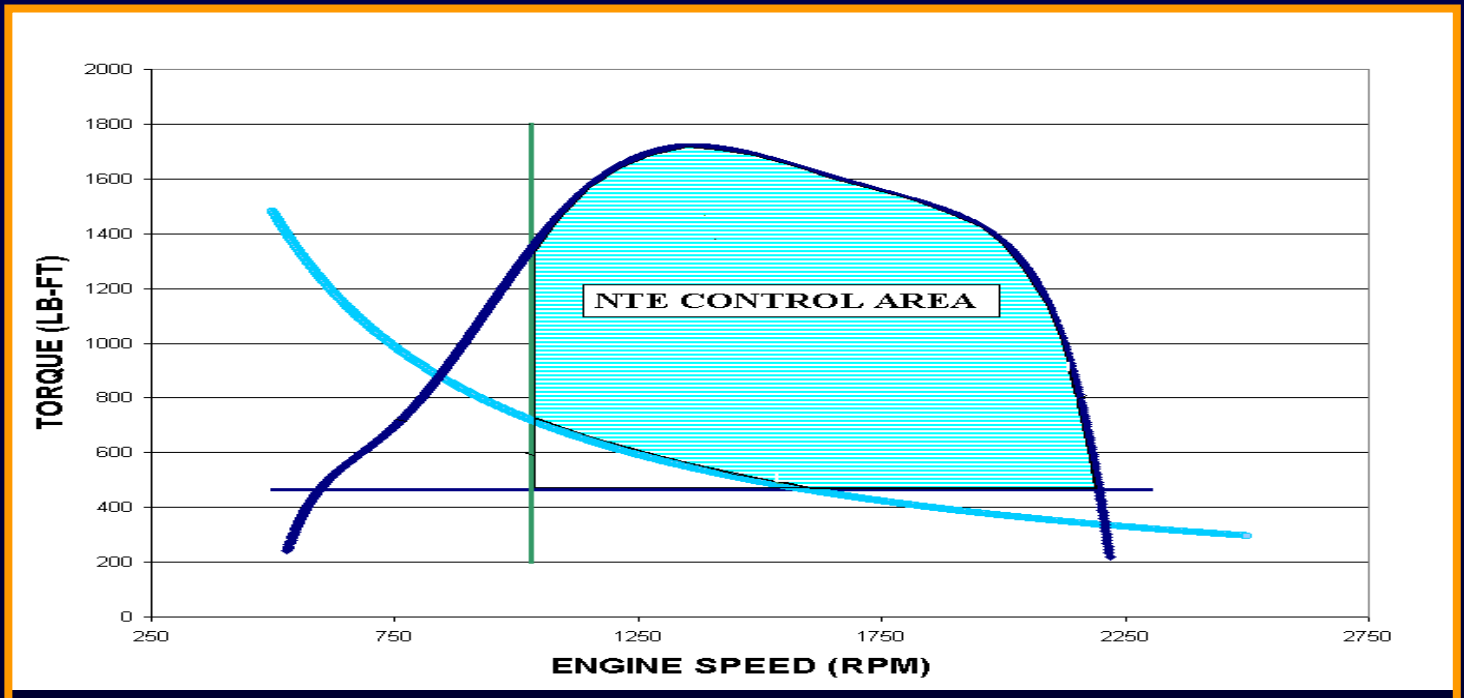
Not-to-Exceed Test is Unique

FTP

- Compliance based on the use of one pre-defined driving cycle
- Compliance based on averaging emission over the entire test
- Limited to engine dynamometer testing only

NTE

- Compliance based on a broad operating range
- Compliance based on multiple sampling periods as short as 30 seconds
- Applicable to engine and chassis dynamometer testing, and on-the-road on-board measurement testing



HDD In-Use Compliance Program

- Manufacturer-run in-use compliance program
  - Collaborative efforts between ARB, U.S. EPA, and EMA since March 2002
  - All major elements agreed upon
  - Compliance determined by Not-to-Exceed testing
- Manufacturer-run program benefits
  - ARB/U.S. EPA
    - Reduce expenses by sharing data
    - Verify compliance with in-use emissions data
    - Check for presence of defeat device
  - Manufacturers
    - Streamline certification process
    - Combined CA/federal program
    - Reduce Selective Enforcement Audit

Program Details

- Test 25% of engine families per year
- Test 1 EF/year for small manufacturer
- Test truck for a full shift in normal operation
- Two phase testing
  - Phase 1: Test up to 10 vehicles (6 + 4) per engine family
  - Phase 2: Required if 5 or more of the 10 vehicles fail, test up to 10 more vehicles
- Test data evaluation
  - May lead to a recall

Program Implementation

- California pilot program in 2005 and 2006
  - Phase 1 testing only
  - Analysis of test results by ARB/U.S. EPA/manufacturers
  - No enforcement action solely on pilot program data
  - Improve and refine the program as needed
- ARB can conduct its own in-use testing
- Fully enforceable program starts in 2007

Heavy-Duty On-Board Diagnostics Program

On-Board Diagnostics (OBD) Systems Background

- OBD systems monitor all emission-related components for malfunctions
- Alert driver by illuminating warning light
- Store diagnostic information for repair technicians
- Have been required on gas and diesel vehicles < 14,000 lbs. GVWR since 1996

Heavy-Duty OBD

- Require monitoring of:
  - Electronic emission-related components
  - Aftertreatment devices
  - Engine misfire
  - Fuel delivery system
  - Other emission controls

Heavy-Duty OBD (Continued)

- Applicability
  - 2007 and later model years
  - Gas and diesel HD vehicles and engines ≥ 14000 lbs. GVWR
- U.S. EPA plans to harmonize by adopting ARB regulation
- Proposal to the Board in late 2003

Increased Incentives for NOx Reductions

- NOx reductions from incentive programs meet ARB's M4 commitments for the South Coast
- Additional NOx reduction will occur through ARB's continued funding of incentive programs
- Additional reductions in excess of ARB's M4 commitment for the South Coast will contribute towards ARB's M17 commitment for 2005 and beyond

In-Use Emission Reduction Programs Summary

Programs	Passenger Cars & Light Duty Trucks	Current HDD Program	With Proposed M17 Programs
Emission Standard	✓	✓	✓
Compliance Program	✓		✓
Smog Check	✓	Smoke Only	Smoke + ?
OBD II	✓		✓

Next Steps

- Continue testing of HDD trucks to evaluate the NOx screening program
- Continue working with U.S. EPA, EMA, and individual manufacturers on finalizing in-use compliance and OBD programs
- Seek additional funding for incentive programs
- Conduct workshop(s)
- Proposal to the Board in late 2003